

**CONTROL ID:** 1818866

**TITLE:** Detection and Quantification of Nitrogen Compounds in Martian Solid Samples by the Sample Analysis at Mars (SAM) Instrument Suite

**AUTHORS (FIRST NAME, LAST NAME):** Jennifer C Stern<sup>1</sup>, Rafael Navarro-Gonzalez<sup>2</sup>, Caroline Freissinet<sup>3</sup>, Christopher P McKay<sup>4</sup>, Paul Douglas Archer<sup>5</sup>, Arnaud Buch<sup>6</sup>, Jennifer L Eigenbrode<sup>1</sup>, Heather Franz<sup>1</sup>, Daniel Patrick Glavin<sup>1</sup>, Douglas W Ming<sup>5</sup>, Andrew Steele<sup>7</sup>, Cyril Szopa<sup>8</sup>, James J Wray<sup>9</sup>, Pamela Gales Conrad<sup>1</sup>, Paul R Mahaffy<sup>1</sup>, MSL Science Team<sup>10</sup>

**INSTITUTIONS (ALL):** 1. NASA Goddard Space Flight Center, Greenbelt, MD, United States.  
 2. Universidad Nacional Autónoma de México, Mexico City, Mexico.  
 3. NASA Postdoctoral Program, NASA Goddard Space Flight Center, Greenbelt, MD, United States.  
 4. NASA Ames Research Center, Moffett Field, CA, United States.  
 5. JETS/Jacobs Technology, Inc., NASA Johnson Space Center, Houston, TX, United States.  
 6. Ecole Centrale Paris, Chatenay-Malabry, France.  
 7. Carnegie Institution of Washington, Washington, DC, United States.  
 8. LATMOS, Univ. Pierre & Marie Curie, Univ. Versailles Saint-Quentin & CNRS, Paris, France.  
 9. Georgia Institute of Technology, Atlanta, GA, United States.  
 10. Jet Propulsion Laboratory, Pasadena, CA, United States.

**ABSTRACT BODY:** The Sample Analysis at Mars (SAM) instrument suite on the Mars Science Laboratory (MSL) Curiosity Rover detected both reduced and oxidized nitrogen-bearing compounds during the pyrolysis of surface materials from three sites at Gale Crater. Preliminary detections of nitrogen species include NO, HCN, CICN, CH<sub>3</sub>CN, and TFMA (trifluoro-N-methyl-acetamide). On Earth, nitrogen is a crucial bio-element, and nitrogen availability controls productivity in many environments. Nitrogen has also recently been detected in the form of CN in inclusions in the Martian meteorite Tissint, and isotopically heavy nitrogen ( $\delta^{15}\text{N} \sim +100\%$ ) has been measured during stepped combustion experiments in several SNC meteorites. The detection of nitrogen-bearing compounds in Martian regolith would have important implications for the habitability of ancient Mars. However, confirmation of indigenous Martian nitrogen-bearing compounds will require ruling out their formation from the terrestrial derivatization reagents (e.g. N-methyl-N-tert-butyldimethylsilyl-trifluoroacetamide, MTBSTFA and dimethylformamide, DMF) carried for SAM's wet chemistry experiment that contribute to the SAM background. The nitrogen species we detect in the SAM solid sample analyses can also be produced during laboratory pyrolysis experiments where these reagents are heated in the presence of perchlorate, a compound that has also been identified by SAM in Mars solid samples. However, this does not preclude a Martian origin for some of these compounds, which are present in nanomolar concentrations in SAM evolved gas analyses. Analysis of SAM data and laboratory breadboard tests are underway to determine whether nitrogen species are present at higher concentrations than can be accounted for by maximum estimates of nitrogen contribution from MTBSTFA and DMF. In addition, methods are currently being developed to use GC Column 6, (functionally similar to a commercial Q-Bond column), to separate and identify unretained compounds such as NO, N<sub>2</sub>O, and NO<sub>2</sub>, which are difficult to detect by EGA-MS due to mass interferences at 30, 44 and 46, respectively. Here we present evolved gas analysis-mass spectrometry (EGA-MS) and gas chromatography mass spectrometry (GC-MS)

data on the identification and quantification of these nitrogen-bearing compounds, and suggestions for their origins.

**KEYWORDS:** 6225 PLANETARY SCIENCES: SOLAR SYSTEM OBJECTS Mars, 5200 PLANETARY SCIENCES: ASTROBIOLOGY.

(No Image Selected)

(No Table Selected)

### **Additional Details**

**Previously Presented Material:**

### **Contact Details**

**CONTACT (NAME ONLY):** Jennifer Stern

**CONTACT (E-MAIL ONLY):** jennifer.c.stern@nasa.gov

**TITLE OF TEAM:** The MSL Science Team

---